

Claims

1. Steel block for the manufacture of moulds for the injection moulding of plastics material or the moulding of metals or for the manufacture of metal-working parts, having a thickness greater than 20 mm, of which the structure is completely martensitic or martensito-bainitic, of which the hardness at all points is between 430 HB and 530 HB and of which the chemical composition of the steel comprises, in % by weight:

$$0.180\% \leq C \leq 0.400\%$$

$$\text{Si} \leq 0.8\%$$

$$\text{Mn} \leq 2.5\%$$

$$\text{Ni} \leq 3\%$$

$$\text{Cr} \leq 3.5\%$$

$$\text{Mo} + \text{W}/2 \leq 2.8\%$$

$$\text{V} + \text{Nb}/2 + \text{Ta}/4 \leq 0.5\%$$

$$\text{Al} \leq 0.4\%$$

$$\text{Ti} + \text{Zr}/2 \leq 0.1\%$$

- boron in a content of between 0.0005% and 0.015%,
- optionally one or more elements from among sulphur, selenium and tellurium, the sum of contents of these elements being less than or equal to 0.2%,
- optionally one or more elements from among lead and bismuth, the sum of contents of these elements being less than or equal to 0.2%,
- optionally calcium in a content of less than or equal to 0.1%,

the remainder being iron and impurities resulting from production, the copper being an impurity, the chemical composition also satisfying the following equations:

$$3.2 \leq Tr \leq 9$$

$$85 \leq Dr \leq 95$$

$$U/Dr \leq 10.0$$

$$Mo^* + 3xV^* \geq 0.4\%$$

in which, for contents expressed in %:

$$Tr = 1.8xC + 1.1xMn + 0.7xNi + 0.6xCr + 1.6xMo^* + K$$

wherein $K = 0$ if the steel does not contain boron and $K = 0.5$ if the steel contains boron

$$Dr = 54xC^{0.25} + 24.5x(Mo^* + 3xV^*)^{0.30} + 1.58xMn + 0.74xNi + 1.8xSi + 12.5x(Cr)^{0.20}$$

$$U = 1600xC + 100x(0.25xCr + Mo^* + 4.5xV^*)$$

$$R = 3.8xC + 10xSi + 3.3xMn + 2.4xNi + 1.4x(Cr + Mo^*)$$

$$Mo^* = Mo + W/2$$

$$V^* = V + Nb/2 + Ta/4$$

the contents of boron, aluminium, titanium, zirconium and nitrogen, expressed in thousandths of % by weight, being such that:

$$B \geq \frac{1}{3} \times K1 + 0.5$$

wherein $K1 = \text{Min} (I^*; J^*)$

$$I = \text{Min}(N; N - 0.29(Ti + Zr/2 - 5))$$

$$J = \text{Min} \left(N; 0.5 \left(N - 0.52 Al + \sqrt{(N - 0.52 Al)^2 + 283} \right) \right).$$

2. Steel block according to claim 1, of which the chemical composition is such that

$$R > 11$$

3. Steel block according to claim 1 or claim 2, characterised in that

$$R \leq 2.7xTr$$

4. Steel block according to any of claims 1 to 3, characterised in that the silicon content is strictly less than 0.45 % by weight and the carbon content less than or equal to 0.35 % by weight.

5. Steel block according to any of claims 1 to 4, characterised in that $R/(2.7xTr) \leq 0.90$.

6. Steel block according to claim 5, characterised in that $R/(2.7xTr) \leq 0.80$.

7. Steel block according to any of claims 1 to 6, characterised in that $U/Dr < 9.0$.

8. Steel block according to claim 7, characterised in that the composition is such that:

$$0.230\% \leq C \leq 0.350\%$$

$$\text{Si} \leq 0.30\%$$

$$0.1\% \leq \text{Mn} \leq 1.8\%$$

$$\text{Ni} \leq 2\%$$

$$0.2\% \leq \text{Cr} \leq 3\%$$

$$\text{Mo} + \text{W}/2 \leq 2.5\%$$

$$\text{V} + \text{Nb}/2 + \text{Ta}/4 \leq 0.3\%$$

$$\text{Mo}^* + 3\text{xV}^* \geq 0.8\%$$

9. Steel block according to claim 8, characterised in that its composition is such that:

$$0.240\% \leq \text{C} \leq 0.320\%$$

$$\text{Si} \leq 0.15\%$$

$$0.1\% \leq \text{Mn} \leq 1.6\%$$

$$\text{Ni} \leq 2\%$$

$$0.2\% \leq \text{Cr} \leq 2.5\%$$

$$0.3\% \leq \text{Mo} + \text{W}/2 \leq 2.5\%$$

$$\text{V} + \text{Nb}/2 + \text{Ta}/4 \leq 0.3\%$$

$$\text{Mo}^* + 3\text{xV}^* \geq 1.2\%$$

10. Steel block according to claim 8 or 9, characterised in that $\text{Tr} > 4.5$.

11. Steel mould part machined in a block according to any of claims 1 to 10, of which at least a portion of the surface is hardened by nitriding and of which the hardness at all points is between 430 HB and 530 HB.